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HUMAN RESOURCES

TEAM TRAINING FOR COMMAND AND CONTROL SYSTEMS:
RECOMMENDATIONS FOR APPLICATION
OF CURRENT TECHNOLOGY

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This paper contains recommendations for solutions to problems in team training (T^2) in command and control (C^2) systems in the Air Force. The recommended solutions are proposed as projects within the current state of technology. They are near-term projects and require only design and preparation for an existing application rather than further development or research. The recommended projects were generated to address issues and problem areas identified in a survey of AFC^2T^2.

Eleven projects were recommended, consisting of taxonomy development, methodology for team task analysis, evaluation of team readiness, guidelines and aids for defining simulated combat mission, formal training material for

Item 20 (Continued):

C^2 system supervisory personnel. development of supplemental skill training for entrants into the air weapons controller career field. formal training for operators of interceptor simulators. procedures for program evaluation. procedures for compiling and using after-action reports. attitude survey of discontent in C^2 career fields. and an instructor resource package for operational unit instructors. The plan for a project to implement a technique for training is discussed in greater detail.

Four additional technical papers are concerned with AFC^2T^2 research: AFHRL-TP-82-7. AFHRL-TP-82-8. AFHRL-TP-82-10. and AFHRL-TP-82-11.

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PREFACE

Throughout the text of this paper. reference is made to volumes I through V. These volumes have been published as separate technical papers identified as follows:

Volume I

Baum. D.R.. Modrick. J. A.. & Hollingsworth. S.R. *Team training for command and control systems: Status.* AFHRL-TP-82-7. Wright-Patterson AFB. OH: Logistics and Technical Training Division. Air Force Human Resources Laboratory. April 1982.

Volume II

Modrick. J.A.. Baum. D.R.. & Hollingsworth. S.R. *Team training for command and control systems: Recommendations for research program.* AFHRL-TP-82-8. Wright-Patterson AFB. OH: Logistics and Technical Training Division. Air Force Human Resources Laboratory. April 1982.

Volume III

Baum. D.R.. Modrick. J.A.. & Hollingsworth. S.R. *Team training for command and control systems: Recommendations for application of current technology.* AFHRL-TP-82-9. Wright-Patterson AFB. OH: Logistics and Technical Training Division. Air Force Human Resources Laboratory. April 1982.

Volume IV

Hollingsworth. S.R.. Modrick. J.A.. & Baum. D.R. *Team training for command and control systems: Recommendations for simulation facility.* AFHRL-TP-82-10. Wright-Patterson AFB. OH: Logistics and Technical Training Division. Air Force Human Resources Laboratory. April 1982.

Volume V

Baum. D.R.. Modrick. J.A.. & Hollingsworth. S.R. *Team training for command and control systems: Executive summary.* AFHRL-TP-82-11. Wright-Patterson AFB. OH: Logistics and Technical Training Division. Air Force Human Resources Laboratory. April 1982.

This paper is the third of five volumes prepared by Honeywell to document the results of a research program to evaluate the current status of team training (T^2) for operators of complex Air Force Command and Control (AFC^2) systems. and to make recommendations for enhancing the AFC^2T^2 process. The research was performed for the Air Force Human Resources Laboratory under contract F33615-79-C-0025.

The purpose of the present volume is to describe AFC^2T^2 problem areas amenable to solution through the application of technology that is currently available. The description of each problem area includes a summary of the issue. a description of sources of information to be used in the solution. the general nature of the solution. its impact. and estimates of contractor and Air Force resources necessary for its implementation.

This research effort supports a major new Air Force Human Resources Laboratory (AFHRL) research and development program whose primary objective is to improve T^2 technologies in areas particularly relevant to Air Force combat readiness. The program objective requires the establishment of a baseline data base on how T^2 is currently conducted in the Air Force: how it is developed. implemented. and evaluated. Because Air Force teams vary greatly in size. structure and functions. it would be impractical to collect data on the training provided to all of them. Rather. the scope of this research effort had to be directed at an area with potential high payoff for increased combat readiness and effectiveness. The area of command and control (C^2) was chosen as a point of departure for the research because C^2 teams tend to be well defined structurally. are of a manageable size. and perform functions highly representative of Air Force mission needs. Furthermore. as the research effort unfolded. limited time and resources made it necessary to focus on tactical and air defense C^2 systems to the exclusion of strategic C^2 systems. Thus. the C^2 systems surveyed are. or in the case of planned systems will become. Tactical Air Command (TAC) resources.

The goal of this effort was to develop a picture, through interview and observation, of how AFC^2T^2 is currently developed, implemented, and evaluated, and what C^2 training needs will arise in the future. Based on this picture, strengths and weaknesses of AFC^2T^2 were identified, and recommendations were developed in three areas:

- T^2 research and development program

- Resolution of issues using current techniques/technologies

- Simulation technology development for C^2T^2

These recommendations will form the foundation for future research by AFHRL into the performance of C^2 teams and systems. The research will encompass training technology, performance measurement techniques for C^2 teams and systems, human resources issues in the design and operation of C^2 systems, and training of command/decision skills. The ultimate goal of this program is to improve technologies in areas of team and human factors related to the combat effectiveness of Air Force C^2 operations.

TABLE OF CONTENTS

TABLE OF CONTENTS (concluded)

LIST OF ILLUSTRATIONS

LIST OF TABLES

LIST OF ACRONYMS

AAR	After-action report
ABCCC	Airborne Command and Control Center
ACMI	Air combat maneuver information
ACWSO	Aerospace control and warning systems operator
ADWC	Air defense weapons center
AFC^2	Air Force command and control
AFC^2T^2	Air Force command and control team training
AFOQT	Air Force officer qualifying test
ATACS	Airborne tactical air control system
ATC	Air training command
AWACS	Airborne warning and control system
AWC	Air weapons controller
AFHRL	Air Force Human Resources Laboratory
C^2	Command and control
CICWO	Combat information center watch officer
CRC/P	Control and reporting center/post
C^2T^2	Command and control team training
DID	Data item description
IPS	Interceptor pilot simulator
ISD	Instructional system development
JSS	Joint surveillance system
MAUT	Multiattribute utility theory
MCC	Mission crew commander
NCO	Non-commissioned officer
OJT	On-the-job training

LIST OF ACRONYMS (concluded)

OTD	Office of Training Development
SAGE	Semi-automated ground environment
SCM	Simulated combat mission
SRB	Source/reference book
STE	System training exercise
T^2	Team training
TACC	Tactical air control center
TACS	Tactical air control system
TRA	Training requirements analysis
TAC	Tactical Air Command

CHAPTER I

INTRODUCTION AND OVERVIEW

The objective of this study was to survey and characterize the status of AFC^2T^2 programs. The methods used to define, develop, implement, and evaluate tactical air C^2 training programs were described, analyzed, and evaluated. The evaluation permitted identification of AFC^2T^2 strengths and weaknesses. The weaknesses were consolidated into issue areas according to whether they involved training program definition and development, implementation, evaluation and modification, or personnel policy and resource constraints. The issues are summarized in Table 1.

The purpose of the present volume is to describe those C^2T^2 problem areas amenable to solution through the application of currently available or refinable technology. The emphasis in the present volume is on identifying existing or potential training technology which could provide near-term improvements in the cost-effectiveness of AFC^2T^2 programs. The description of each problem area includes a summary of the issue, the specific sources of information that could be used in the solution, the general nature of the anticipated solution, its impact, estimates of contractor resources necessary for full development, and estimates of Air Force resources necessary for implementation.

Each proposed solution is further evaluated as to appropriateness for inclusion in a user-oriented source/reference book (SRB). The SRB would present procedures to be used by training developers and managers to

1

TABLE 1. AFC^{2}T^2 ISSUES AND PROBLEM AREAS

Definition and Development	Implementation (concluded)
Lack of a definitive framework for identifying and analyzing team aspects of operational systems and defining team-oriented task structure.	Lack of training for personnel who simulate interceptor pilots during initial and initial transition training.
Lack of objective criteria and standards for evaluating team-oriented skills, individual and team readiness, and system effectiveness.	Lack of AWACS-oriented block of instruction in Air Weapons Controller Fundamentals or APQ Courses.
Lack of analytic techniques and empirical data for determining institutional and operational T^2 requirements and objectives.	Lack of instruction for supervisors, battle staff personnel, and decision-makers.
Lack of comprehensive, systematic procedures for defining training objectives for simulated combat missions.	Program Evaluation and Modification
	Lack of valid evaluative measures for initial and initial transition training programs.
Inadequate planning and analytic techniques for defining T^2 simulation/simulator fidelity and functional requirements.	Incomplete use of existing evaluative data for system exercises/simulated combat missions.
Failure to define and develop formal training for C^2 system supervisors.	Personnel Policy and Resource Constraints
Implementation	Low retention rate of experienced C^2 system personnel.
Deficient simulator capabilities including a lack of facilities for combined systems training.	Shortage of live flying intercept events and BCM activities for T^2.
Mismatch between entry-level requirements and Air Weapons Controller Fundamentals Course syllabus.	Inadequate instructor training and evaluation in operations training program.
	Difficulties posed in training and evaluating "soft" as opposed to "hard" teams.
Lack of empirical data regarding the optimal instructional methods and sequencing for subteam, team, and superteam skill training.	Inadequate understanding of C^2 training pipeline on the part of C^2 training program managers.

2

develop training materials for C^2 team supervisors. The SRB would describe procedures for developing a job task list, identifying skill categories, establishing skill acquisition guidelines, defining experience exercise requirements, selecting appropriate media, and developing scripted exercises. The criteria by which solutions are judged appropriate for an SRB are fully documented. These criteria include problem area frequency and criticality, solution generality, intended users, and ease of solution application by the user.

The remainder of this volume is organized into three chapters. The description and evaluation of issues are presented in Chapter II. The topic selected for application in Phase II of this effort is described in fuller detail in Chapter III. The material to be included in the SRB is presented in outline format in Chapter IV. The outline has been annotated to indicate the type or depth of coverage each topic should receive.

CHAPTER II

DESCRIPTION AND EVALUATION OF AFC^{2}T^2 ISSUES AMENABLE TO SOLUTION THROUGH EXISTING TECHNOLOGY

This chapter presents those C^{2}T^2 issues judged amenable to solution through the application or refinement of existing training technology. Each issue is described in terms of the approach, impact, and cost of the proposed solution. The appropriateness of including each issue in an SRB is also evaluated.

The statement of approach and resources required for each issue is stated more globally in the present volume than is ultimately needed for planning and implementing the project. However, a more detailed statement requires at least one more iteration of the recommendations. That iteration would provide more detailed information and better definition of the specific topic, materials to be designed and prepared, and the research methodology and procedure to be followed. At that point, person-year requirements and budget could be estimated. Such information is not available at present, nor are there resources to support the analysis. The present level of discussion is intended to identify research objectives and strategies, which may then become the basis for more detailed planning.

Table 2 summarizes the specific close-in applications discussed in this chapter. The issues listed in Table 1 have been restated as solutions or development approaches. Some of the issues listed in Table 1 are much more general than others; in these instances, the proposed specific need

4

TABLE 2. IMMEDIATE APPLICATIONS FOR RESOLVING C^2T^2 ISSUES

<u>Definition and Development</u>

- Taxonomy for identifying and classifying team-oriented tasks and skills

- Methodology for analyzing team-oriented tasks

- Criteria for evaluating team readiness

<u>Implementation</u>

- Guidelines and aids for defining simulated combat mission training objectives and characteristics

- Formal training material for selected C^2 system/team supervisory personnel

- Supplemental training in selected skills for entrants into the Air Weapons Controller career field

- Formal training for intercept pilot simulators

<u>Evaluation</u>

- Improved validity of T^2 program evaluation questionnaires

- Procedure for compiling after-action reports into a training exercise data base

<u>Personnel Policy</u>

- Attitude surveys to pinpoint sources of discontent in C^2 career fields and recommend changes

- Instructor resource package for operational unit instructors

deals with an initial step that can be made using current technology. Some
general issues have spawned more than one development need. For
example, techniques exist for a first step to develop a conceptual framework
for identifying and analyzing team skills; the proposed approach to develop-
ing training materials for C^2 team supervisors can provide a relatively
complete solution to the problem of a lack of formal training for those
personnel.

T^2 DEFINITION AND DEVELOPMENT

A fundamental problem in T^2 definition is that current Instructional
System Development (ISD) guidelines and procedures do not address team-
oriented tasks and skills. Rather, ISD focuses on an operator's individual
knowledge and skill requirements, especially as related to structured tasks
with equipment-oriented procedures. This focus is necessary but is not
sufficient to deal with task performance involving interpersonal inter-
action and requiring cognitive, team-oriented skills.

The major goal of the training requirements analysis (TRA; sometimes
called front-end analysis) of the ISD procedure is the specification of
training objectives. The steps in this analysis have been described
elsewhere in this report (Volume I, Chapter II). They are:

1. Identify job requirements

2. Select tasks to be trained

3. Analyze selected tasks

4. Construct job performance measures

5. Develop training objectives

6

Other frameworks exist for systematically carrying out a TRA. For example, Smode (Reference 1) presented a five-step process which is at a more basic level than that outlined above. A summary of the procedures can be found in Hall and Rizzo (Reference 2) or Denson (Reference 3).

1. Describe and analyze operational system

2. Define the task structure

3. Analyze tasks

4. Prepare detailed task statements

5. Express task statements in the form of training objectives

These two sets of steps are by no means incompatible. The identification of job requirements, for example, is based on an analysis of the operational system and definition of the task structure. A good approach would be to merge the procedures, ensuring that the level of detail implied in Smode's process is not lost in the merger.

It is not enough, however, simply to present the steps of a procedure and describe what is to be done. The conceptual framework determines the nature of the output which accompanies the implementation of the steps. Current frameworks do not possess, for example, a classification scheme which allows identification of team-oriented tasks. Nor do they have a methodology for the analysis of tasks requiring team-oriented knowledges and skills, or comprehensive techniques for evaluating team performance and readiness. The development of such tools is within the current state of the art in training technology.

There are three interrelated efforts which can be undertaken to develop and apply available techniques to overcome these shortcomings of the TRA:

1. Develop taxonomy for identifying and classifying team-oriented tasks and skills.

2. Develop methodology for analyzing team-oriented tasks.

3. Develop criteria for the evaluation of team readiness.

The first two efforts are focused on the definition of T^2 requirements for the individual. The third effort is aimed at the team as a whole.

Taxonomy Development

Examples of task taxonomies abound in the literature of training and human factors (References 4 through 8). The extant taxonomies are characterized by having been developed for fairly narrow applications or with a particular orientation to taxonomic issues and purposes. Of pertinence to the present case is that all of these taxonomies deal with tasks performed by a single operator. Despite this fact, the existing behavior taxonomies are a primary source of information which can be used to develop a taxonomy oriented towards describing and classifying team behaviors.

A second important source of information is the operational team environment. Observations of actual teams carrying out (simulated) combat missions must be undertaken to develop and validate the taxonomy. To achieve representativeness and generality, the Tactical Air Control System (TACS), Tactical Air Control Center (TACC), or Control and Reporting Center/Post (CRC/P) should provide the observation environment.

Initial observations would be carried out with a taxonomy developed with a cognitive skill orientation; data descriptive of task frequency over mission segments would be collected.

The result of this ethological study of teams will be a behavioral taxonomy which forces attention to team-oriented tasks in the initial steps of the ISD procedure. This revision of the ISD procedure will permit accommodation of the definition of T^2 requirements and objectives in a systematic, verifiable fashion.

This is a difficult and complex task. It is estimated that full development of the taxonomy would require the following contractor resources: Two and one-half person-years of effort would be necessary, divided among a full-time senior and a junior psychologist, both of whom are knowledgeable in the C^2T^2 area, and a half-time research associate. Field observations would require extensive cooperation and understanding of participating units and a substantial amount of travel on the part of the researchers. The time course of the study would be determined primarily by the frequency of training exercises, but a minimum of three observations would be necessary. Required resources include a data recorder and access to computer facilities for data reduction. Gunning and Manning (Reference 9) discuss the use of this strategy in the context of an aircrew task loading study.

The implementation of the taxonomy as a front end to the ISD procedure will require no substantial Air Force resources beyond publishing a revision of the Air Force ISD model to be used by all training developers. It is important to note, however, that the use of a revised ISD procedure

with a team behavior orientation can be expected to result in more effective but, perhaps, more expensive training. The ultimate cost (or savings) will depend on the specific T^2 objectives that result and how they are sequenced throughout existing training programs.

The taxonomy developed through this effort would be appropriate for inclusion in an SRB. The problem addressed is common to all T^2, as is the proposed solution. Furthermore, according to the posture adopted herein a team behavior taxonomy is the first step in the development of a conceptual framework embracing teams and team-oriented skills, the missing fundamental element in T^2 definition and development.

Develop Methodology for Team Task Analysis

Identifying and classifying team-oriented tasks is the first step necessary in defining T^2 objectives. Task analysis is the second step. Current task analysis methods provide for analysis of individual operator tasks. These methods must be upgraded to support the analysis of team-oriented tasks.

The purpose and results of a task analysis are discussed in Chapter II of Volume I. Briefly, conditions and standards of task performance are determined. The results are a detailed description of tasks and task steps, and associated environmental and equipment conditions and behavioral criteria of performance.

Perhaps the most significant shortcoming of current task analysis methods is that they are primarily equipment-oriented. It is infrequently acknowledged that environmental conditions often include a team environment. The

performance of certain tasks will be contingent upon receiving or transmitting, either verbally or machine-assisted, information from or to another team member; or tasks will be coordinated in sequencing and timing with other team members or elements. Take, for example, data item description (DID) DI-H-6130, Task and Skill Analysis Report (Reference 10).

Table 3 presents the DID instructions for producing a description and analysis of operator tasks. The data format is a matrix, as shown in Figure 1. Clearly, there is little room for the inclusion of team-oriented tasks and skills in the analysis. Importantly, task analysis techniques in various ISD procedures are essentially the same as that in DI-H-6130.

Based upon the data obtained in developing a team-behavior taxonomy, the ISD and DI-H-6130 task analysis formats should be expanded to produce detailed descriptions of tasks involving interpersonal dependencies and interaction. Such descriptions should be from a cognitive skill perspective. Determining the conditions and standards of the performance will require subject matter expertise related more to efficient and effective C^2 team performance than to the specific system which is the subject of analysis. That is, the expert should be a generalist of supervisory rank rather than a technical specialist.

It is difficult to estimate the contractor resources necessary to fully develop a revised ISD task analysis or DID for a Task and Skill Analysis Report; it is an ambitious undertaking and is at least partially contingent upon the success of the taxonomy development. If the same contractor were involved

TABLE 3. INSTRUCTIONS FOR CARRYING OUT OPERATOR
TASK ANALYSIS (from DI-H-6130)

EXHIBIT 1

OPERATOR TASK DESCRIPTIONS AND ANALYSIS

Exhibit 1 identifies and provides the specific operator tasks and related
equipment required to operate and support the aeronautical system/subsystem/
equipment.

Instructions for Completing Exhibit 1

Block No.   Instructions

1   Nomenclature--Enter nomenclature, part number, etc.
                Date--Enter date of preparation/revision.

2   Task Identification--Make an alphanumerical listing of
                tasks which will provide easy identification and
                correlate with maintenance engineering analysis data
                where applicable. Tasks shall be grouped by subsystem
                and in chronological order.

3   Task Description--Enter the complete task description.

4   Step Number--Enter the numerical listing of each task
                step.

5   Step Description--Enter the logical sequential steps for
                task performance. A description of any human factor
                considerations such as environmental conditions, speed
                of action, perception, coordination, physical dexterity,
                safety, etc., shall be included. A description of system/
                equipment condition which is necessary prior to the task
                accomplishment shall be included.

6   Equipment--Enter a listing of equipment, tools, test
                equipment required for the specific task step.

12

EXHIBIT 1

OPERATOR TASK DESCRIPTION AND ANALYSIS

1. NOMENCLATURE _____ DATE _____

TASK STEPS IDENTIFICATION AND ANALYSIS

2. TASK IDENT.	3. TASK DESCRIPTION	4. STEP NO.	5. STEP DESCRIPTION	6. EQUIPMENT

Figure 1. Format for Operator Task Description and Analysis (from DI-H-6130)

in the two developments, a great economy could be achieved. Under these conditions the level of effort required would be 1 1/2 person-years divided among a quarter-time senior scientist, a quarter-time junior scientist, and a full-time research associate. The cooperation and participation of knowledgeable Air Force personnel would be essential. The Tactical Air Control System Office of Training Development (TACS/OTD) could provide the required expertise and test bed for development and implementation. The duration of this effort would be on the order of six months.

Air Force resources required for the implementation of a revised ISD or DI-H-6130 task analysis would not be substantial. The impact would be improved identification of team performance requirements and training objectives. However, as with the team behavior taxonomy, it is difficult to predict the ultimate cost or savings of T^2 based on systematically-derived T^2 objectives.

The revised task analysis methodology developed through this effort would be appropriate for inclusion in an SRB. The same criteria apply here as in the taxonomy development. The problem addressed is both general and critical, and the proposed solution will be usable by the intended users because it is an extension of an existing method.

Develop Criteria for Evaluating Team Readiness

What are the dimensions of team performance to which an expert evaluator attends? What criteria does an expert apply to judge the combat readiness of a team? These questions are candidates for development involving the application of multiattribute utility theory (MAUT) to team evaluation decision-making.

At present the evaluative techniques for determining the readiness of teams are either objective and uninformative or too subjective to be of use in training effectiveness assessment. Number of exercises participated in and staffing level are examples of objective measures with little information. On the other hand, the format of narrative reports such as the after-action report (AAR), while providing a source of useful information regarding team performance, tends to be unsystematic and loosely structured. A solution to this problem lies in the development of an evaluative tool which structures and externalizes expert judgment. MAUT provides the means of developing an evaluative tool with those desirable characteristics.

The approach of MAUT consists of extracting from experts the independent dimensions which they consider important in a particular decision context and then obtaining assessments of the value or utility of particular attributes on the dimensions. For example, in the tactical air C^2 area a dimension of readiness might be the timely transmission of target status information from the surveillance section to the weapons section. Particular attributes might be reflected by an all-or-none outcome, for example, target data transmitted, or a utility contingent upon the delay transpiring between a change in target status and data transmission.

The benefits of MAUT have been successfully demonstrated in the context of Marine Corps readiness evaluation (Reference 11); but this application was aimed at a higher level of detail than that required to solve the present problem. Nevertheless, the MAUT decision analytic framework should be readily applicable to the evaluation of C^2 team readiness. The development of a systematic, highly-structured measurement tool is essential to the accomplishment of effective T^2 and valid T^2 research.

Contractor resources required to fully develop a technique for C^2 readiness
assessment are estimated at between four and five person-years
over a 12 to 18-month period. The person-years should be distributed
equally among a senior psychologist with expertise in the C^2T^2 area, two
decision analysts with expertise in applying MAUT, and an experienced
research assistant. Extensive involvement of Air Force standardization/
evaluation personnel would be necessary. A representative and general
solution could be achieved by using an element of the TACS as the object
of the development.

Implementation of a fully-developed technique for readiness assessment
would require training of all C^2 standardization/evaluation personnel and
the institution of a management information data base for organizing the
evaluative data and procedures for using it.

This development of the technique as a topic is not appropriate for inclusion
in an SRB. However, the implementation of a technique for readiness
assessment would be best accomplished within the SRB framework.

T^2 IMPLEMENTATION

Develop Guidelines and Aids for Defining Simulated
Combat Mission Training Objectives and Characteristics

Simulated combat missions (SCMs) or system training exercises (STEs) are
the primary vehicles for accomplishing T^2 in operational units. The
overrriding requirement for SCMs/STEs is that C^2 teams experience the
quality and quantity of events and activities which might occur in actual

16

combat. In order to specify the characteristics of SCMs/STEs, working
group conferences meet on a regular (quarterly) basis to plan them. The
planning procedure is ad hoc and is usually constrained by limited live
resources. There is currently no set of guidelines or aids for defining
training objectives or for specifying the characteristics of SCMs/STEs
necessary to meet the objectives. In fact, the characteristics of the
exercise are typically established as permitted by available resources or
other constraints. The establishment of training objectives is a byproduct
of this rather than the reverse.

The definition of training objectives and characteristics for SCMs/STEs is
complicated by a number of factors. It requires expertise in military tactics
and doctrine, own and enemy, plus additional knowledge derived primarily
from combat experience. Past performance strengths and weaknesses of
the C^2 team or type of team must be factored in to include both team and
mission task skills. System mission objectives, especially new objectives
growing out of superteam needs (for example, the Airborne Tactical Air
Control System--ATACS--which combines AWACS and ABCCC, or inter-
service), play an important role. Furthermore, these objectives must be
put into a realistic context characterized by a world- wide military
potential for TACS and AWACS. The context is defined by a battle scenario
supported by a script and radar simulation or live flying, if available.

It follows that as a result of the difficulties of defining SCMs/STEs, they
are difficult to evaluate for validity and training value. Subject matter
expertise is crucial in all phases of the definition and conduct of SCMs/STEs.
Yet the complexities of the planning task might exceed man's unaided

information management abilities. This could account for the lack of systematic approaches to the definition of training objectives for and characteristics of SCMs/STEs.

Resolution of this problem lies in the development of information management tools which can be used by exercise planners to carry out their task in a more systematic manner. The primary source of information for development of such tools is the planning conferences themselves. Observation of several conferences will provide an understanding of how SCM/STE planning is currently done. This is necessary because any guidelines or aids developed should not depart significantly from present methods, however loosely defined. Otherwise the developed tools will be used ineffectively--or not at all. In addition, the conferences will also provide information on exercise objectives and constraints, as well as information about the characteristics and needs of potential users.

The constraints placed on the definition of SCMs/STEs must be fully appreciated. These include resource and policy constraints as well as simulation capabilities and the like. The alternatives and options available when confronted with such constraints may be expandable or may generate ideas for further R&D.

Finally, observation of conferences is important because the intended users of the guidelines and aids should participate in their development to as great a degree as possible. They must feel ownership for the tools developed as a result of this effort.

Contractor resources required for full development of tools for the definition of SCM/STE training objectives and characteristics would be on the order of four to five person-years over a 12 to 15-month period. The expertise of personnel should include AFC^2 tactics, doctrine, and operations, in addition to training and simulation. Staffing level would be two senior scientists, one full and the other half-time, and two junior scientists, both half-time, plus a full-time research assistant. The staffing level is a function of the number and different types of planning conferences which need to be studied in order to ensure a general solution. At a minimum, two planning conferences for Blue Flag, TACS, and selected Semi-Automated Ground Environment (SAGE) exercises should be observed, and one conference of each type should serve as a test bed for implementation of fully-developed guidelines. Attendance at these planning conferences will require travel and the support of Air Force personnel. Also, Air Force personnel need to be available for consultation during the entire period of the development effort.

Given the emphasis on ownership that is required for the final product and the heavy involvement for this and for technical accuracy of Air Force personnel, an alternate strategy for development would reduce the contractor's role significantly to that of a consultant, for example, one to two person-years over a year's effort. The major development effort under this alternative would be accomplished by Air Force SCM/STE planning personnel.

Implementation resources required to use the tools developed under this effort would be minimal. The conduct of planning conferences would be affected, but they would be carried out in a more systematic fashion. Organizational memory should be enhanced because the loss of experienced planning personnel would not result in as protracted a learning curve for replacement personnel as is now the case. The impact of implementation would be that SCMs/STEs more clearly show a relationship between T^2 objectives and the quality and quantity of events and activities which occur.

The results of this effort would certainly be appropriate for inclusion in an SRB. The solution addresses a problem that is both general and critical. The emphasis on the intended user in development, especially under the alternate strategy discussed above, would ensure a useful product that is in fact used.

Develop Formal Training Material for Selected C^2 System Supervisory Personnel

Knowledgeable, skilled leaders are essential for effective team performance. Team leaders usually occupy positions of supervision and management. The skills required in such positions are almost exclusively of the cognitive, team-oriented variety.

It is often assumed that Air Force officers and Senior NCOs possess supervisory and management skill by virtue of their experience or education (Air Force courses are offered in leadership and management), and this is certainly warranted to some degree. However, the skills may not be fully developed when personnel turnover creates an opening which must be filled. Furthermore, and more critically, effective supervision and

management within a particular C^2 system demands a great deal of knowledge regarding the procedures, problems, and general solutions which are applicable in various mission phases or types of missions. Much of the required knowledge for dealing with established situations is presented in positional handbooks. However, there are no standard references for emergent situations and there is no substitute for extensive observation and experience in acquiring strategies for problem solving under emergent conditions.

The training of tactical air C^2 system supervisors is carried out on the job according to the master-apprentice instructional model (see Volume I, Chapter III). There is no formal, that is classroom, instruction offered and there are few, if any, training aids or materials available. These shortcomings were acknowledged by many survey respondents. As one SAGE student Senior Director aptly expressed it: "Trying to learn how to be a Senior Director from a manual is like trying to learn English by reading the dictionary." Consider in this light that training for SAGE personnel is the best conceived among the systems surveyed.

The need to develop formal training for supervisors is recognized and, in fact, the 966th AWACS Training Squadron has plans to develop instructional modules for the Senior Director and the Mission Crew Commander. This, however, has a lower priority than the development of instruction for Weapons Directors and Surveillance personnel. Similar plans do not at present exist at the TACS/OTD. Without some structured formal training new supervisors are unsystematically exposed to their jobs, resulting in a potential lack of standardization among team leaders.

The resolution of this problem requires accelerated development of formal training for AWACS supervisors and the initiation of development for TACS and JSS supervisors. Combat-ready supervisors and training specialists must collaborate to solve the problem.

As discussed earlier, ISD in its present form does not support the development of T^2. However, creative use of the ISD type of framework has resulted in innovative solutions to supervisor training. McCutcheon and Brock (Reference 12), using a job task inventory for the Combat Information Center Watch Officer (CICWO) produced by Rundquist (Reference 13), developed an audio/visual conceptualization program for use in the CICWO course. The results of Rundquist's task analysis indicated that monitoring and evaluating were two key job actions required of the CICWO. Following the development of classroom exercises permitting practice in monitoring and evaluating tasks (Reference 14), McCutcheon and Brock developed two versions of a "Concepts of CIC" program. These programs showed "a hypothetical CICWO detecting errors, making recommendations to the bridge, and so on." Experimental use of the programs indicated that students who viewed them performed significantly better than controls in subsequent tests.

The method of task analysis used by Rundquist (Reference 13) is similar to current techniques. The key seems to have been in the selection of a training medium appropriate to cognitive skill acquisition. There is no reason why this approach cannot work in the domain of Air Force C^2T^2.

The development effort suggested here does not necessarily have to result in a full-blown course for a C^2 system supervisor. Although that is a desirable final goal, an achievable near-term goal would be the specification and production of training material in the spirit of McCutcheon and Brock (Reference 12), which has demonstrated training effectiveness.

The contractor resources required for full development of exemplary training material would be 1.5 to 2 person-years for a period of six to nine months. Great economy could be achieved if this effort were integrated with the development of a team task and skill taxonomy and a task analysis method. Personnel qualifications include knowledge of AFC^2T^2, instructional technology, and media production. Additional resource considerations would include film or videotape production facilities and associated materials. Participation of an experienced C^2 system supervisor is a necessity, preferably one with a training background. Depending upon the exact nature of the subject matter, filming or videotaping a mock combat mission will be necessary.

The implementation of the final product would require no substantial Air Force resources. Improved training and performance effectiveness could be achieved for little cost. Reduction in the amount of on-the-job training (OJT) required is possible; this would have a positive cost impact.

The methods used to develop the training material would be appropriate for inclusion in an SRB. The problem addressed is ubiquitous in AFC^2T^2. Training developers should be able to readily use the approach and methods outlined above.

Develop Supplemental Training in Selected Skills for
Entrants into the Air Weapons Controller Career Field

The demand for Air Weapons Controllers (AWCs), owing to low retention rates and new system deployment, is extremely high, while job candidates are in short supply. Therefore, in order to maintain full manning levels, the Air Force has not been able to be selective in choosing individuals for this career field. The consequence is a mismatch between the basic skills required by the AWC job and student qualifications.

The gap created by this mismatch can be closed by introducing certain remedial training lessons into the AWC Fundamentals course curriculum. The responses of instructors during the interviews indicated that remedial training appears to be required in mathematical and communication skills. Certain spatial reasoning abilities might also be the subject of training.

Development of supplemental training should proceed in an orderly fashion beginning with an assessment of deficiencies in mathematical and communication skills. This information could be obtained from existing records of test scores (for example, the Air Force Officer Qualifying Test--AFOQT) for past and present students. Alternatively, the mathematical and communication skills required by the AWC job could be analyzed--it was evident from the survey that algebra and geometry are key mathematical skill areas--and specific achievement tests could be given to the student population and samples of recent course graduates and combat-ready controllers.

Once deficiencies are pinpointed, the appropriate remedial training can be identified. It is likely that programmed instruction self-study modules already exist for the skills required, so full-scale development of training would be unnecessary.

The ability to reason spatially, commonly assumed to be highly correlated with mathematical ability, is an important attribute of good controllers. To some degree this ability is more of an aptitude than a skill and so training would not be expected to have a large effect. However, there are certain experiences that would appear to be beneficial in providing AWC students with a frame of reference for the tasks they perform. The difficulty that many students have in adopting a "God's-eye" perspective on the situation display (see Volume I, Chapter III) may be related more to experience than to innate aptitude. After all, the comparable information source most familiar to AWC students is a television or videogame. The situation display represents a different sort of environment; overcoming the initial problems some students have in adopting a God's eye view might be resolved through a visual experience which makes the difference clear.

One approach to resolving the problem would be to make use of videotapes or film of the displays of the Air Combat Maneuver Information (ACMI) system in use at the Air Defense Weapons Center (ADWC). The ACMI system is capable of displaying views of aircraft radar returns from different perspectives including vertical and horizontal. The "three-dimensionality" inherent in the combination of these views might provide exactly the experience needed to jar the AWC students' perception. The aphorism regarding the relative values of pictures and words certainly holds true in this instance.

The contractor resources necessary to fully develop the proposed solutions
are minimal. The effort can best be accomplished by the Air Training
Command (ATC) assuming that the instructors have access to expertise
in education technology and audio/visual media production. This further
assumes that the instructors are authorized to pursue these suggested
solutions and are given the time to accomplish them.

Remedial training of the sort proposed, that is, programmed instruction
self-study, will not be costly to the Air Force. Increases in training
effectiveness and in graduate quality can be achieved for a minimal
investment in materials.

This proposed solution is not appropriate for inclusion in an SRB. The
emphasis should be on positive action to identify the specific needs and
to implement the required remedial training. Supporting background
material on skills, entry requirements, and their relationship to learning
and remediation should also be provided.

Develop Formal Training for Interceptor Pilot Simulators

Interceptor pilot simulators (IPSs) are those personnel who simulate
pilots when necessary during institutional or operations training of AWCs.
Typically in initial and initial transition training, the IPS is an Aerospace
Control and Warning Systems Operator (ACWSO), surveillance technician,
plotter, teller, recorder, etc., who has not achieved combat-ready
status. In transition, upgrade, and continuation training the IPSs are
experienced ACWSO personnel or AWC instructors.

The task of an IPS is to provide the necessary dialogue for AWC-pilot subteam training. Some of the dialogue can be anticipated and put into a script. However, ACWSOs have had no piloting experience and little if any flight experience, and beyond instructions in equipment operation and vocabulary they have had no training. Consequently, the training experience for the AWC is suboptimal, especially when the situation is not scripted. This problem is highly noticeable in initial and initial transition training.

Some motivated IPSs were observed during site visits to take their temporary job seriously. Some, for example, adopted three different voices to represent three different pilots. Comments by students and instructors indicated that this practice improved the training value of exercises. These self-taught IPSs need to be more widely emulated.

A reasonable approach to this problem would be to develop a training package aimed at raising the level of skill and motivation of IPSs. It may well be that a better understanding of their role and impact would improve their motivation sufficiently. This development could be carried out fairly readily on an in-house, that is, Air Force, basis. Contractor support could be obtained to aid the specification of IPS tasks and training requirements. Such support could be obtained on a level of effort basis not to exceed one-half person-year of a junior scientist.

Development of an IPS training package would, in our opinion, improve training effectiveness by increasing the realism of simulation exercises. Preparation of the package would entail only a small investment. If a self-study approach is adopted, the Air Force implementation cost would be negligible.

The results of this effort would be appropriate for inclusion in an SRB. This would be primarily in the nature of the identification of a training resource for the T^2 program manager, not the materials themselves, which could be made obtainable through the Air Force documentation systems.

T^2 PROGRAM EVALUATION

Improve Validity of T^2 Program Evaluation Procedures

Current questionnaire approaches to initial and initial transition training program evaluation are of suspect validity. Comments and criticisms from operations personnel are often taken with a "grain of salt" because they have dwelled on the fact that students lack preparation in procedures and techniques which are required or taught locally. Consequently, the institutional personnel feel that the operational personnel are not sensitive to their problems and training requirements. Improvements in the quality and quantity of the questionnaire data received by the schools from the field could enhance program evaluation and modification. A better-articulated purpose and structure of the questionnaire technique would enable the field personnel to address issues related to job requirements, including team-oriented skills. Furthermore, the school could use the questionnaires to provide more quantitative data regarding the success of the students they trained, such as the time to upgrade to combat-ready status.

The state of the art in opinion surveys has made significant advances in the last several years; for example, poll-taking. Program evaluation has become a scientific endeavor, although the construction of useful questionnaires remains something of an art. A critique of the questionnaires currently in use in AFC^2T^2 should be undertaken to determine in which areas additional information is needed or in which format the probability of obtaining useful, valid information is maximized. A revised questionnaire would then be developed and administered by the schools to a sample of operational sites. It would be evaluated in terms of coverage and the reactions of users and respondents.

This development effort would require a six- to nine-month period of performance. Personnel would consist of a half-time senior scientist, a full-time junior scientist, and a full-time research aide. Requisite skills are in the areas of program evaluation, survey development and implementation, and statistical methods.

Air Force implementation costs associated with the development of an improved questionnaire would be negligible except for personnel time. However, depending upon the results there will, of course, be costs associated with program modification.

Perhaps the biggest benefit of undertaking this effort would be to close the loop between the field and school environment by reducing the mismatch between training and operational needs.

The resultant questionnaire could be included in an SRB. The questionnaire should be program-independent, and AFC^2T^2 program managers should

be able to use it within guidelines provided in an SRB. It thus could be a universal tool in program evaluation for AFC^2T^2.

Develop Procedure for Compiling After-Action Reports into a Training Exercise Data Base

The after-action report (AAR), which characterizes team and system performance as observed during STEs/SCMs, is not used to its fullest advantage in T^2 program evaluation. The AAR currently is used only as a "one-shot" mechanism. A compilation of AARs with analysis and synthesis would provide data descriptive of positive and negative aspects of team performance. The data could be used in numerous ways including the following:

1. Improve the AAR format so that it more directly addresses feedback to teams about team-oriented skills.

2. Identify issues requiring improved training or modified or new operating procedures.

3. Identify issues of system design which affect team performance.

4. Provide a reference for new team members, especially supervisors.

5. Provide a rich source for specific research issues.

The procedure for compiling the AARs should consist of an analysis framework like that depicted in Figure 2 and a synthesis framework like that depicted in Figure 3.

PERFORMANCE CONTEXT

	PRE-TEAM	TEAM	SUPERTEAM
MISSION			
TEAM-ORIENTED			

TASK/
SKILL
CATEGORY

Figure 2.   Analysis Framework for After-Action Reports

ELEMENT

	HUMAN	SYSTEM	OPERATING PROCEDURES
STRENGTHS			
DEFICIENCIES			
OPERATIONAL CONSEQUENCES			

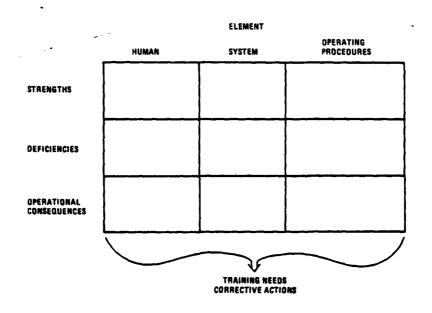TRAINING NEEDS
CORRECTIVE ACTIONS

Figure 3.   Synthesis Framework for Compiled AAR Data

31

Figure 2 shows that the data from AARs can be sorted into task/skill categories applicable to different performance contexts. The performance contexts have been described in Chapter I, Volume I. Individual and subteam contexts have been collapsed into a preteam context for this use.

The mission tasks are operationally defined by the system and the particular STE/SCM scenario. The team-oriented tasks include the following:

- Communications, for example, discipline

- Adaptability to emergent events

- Anticipation, for example, consequences of own action of information needs of others

- Adjustment to workload modification

- Problem solving/decision-making

Figure 3 shows the framework which would be used to synthesize the compiled data. There are three different elements which may be characterized in terms of strengths, deficiencies, and the operational consequences. These elements are human, system (that is, hardware and software), and operating procedures which vary from well-defined (established) to ill- or non-defined (emergent). The operational consequences of deficiencies will lead to recommendations regarding training needs or corrective actions involving, perhaps, system design (future systems, for example) or the development or modification of operating procedures.

This application effort would require one half-time senior psychologist, one full-time junior psychologist, and one half-time research associate.

The period of performance would be six to nine months. A prerequisite for successful performance is intimate knowledge of AFC^2T^2, C^2 systems, and T^2 technology, such as it is.

Development of the compilation procedure would require the cooperation of a stan/eval section of the target system (a CRC would be ideal). Implementation of the developed procedure would require participation by stan/eval personnel and T^2 program managers. The task of compiling past AARs would add to the already high workload of these personnel, but it would be justified if T^2 effectiveness were increased. If the result of this effort lent itself to a revised procedure for generating AARs (for example, feedback-oriented reports), this could have a large positive impact for a small imposition on current workload.

The procedures developed under this effort would be appropriate for inclusion in an SRB. The compilation procedure would, however, be difficult to use and would require some special expertise or analytic skills which AFC^2T^2 personnel might not possess. It is therefore more likely that a revised AAR generating procedure could be successfully implemented in an SRB format because it would extend a current procedure or at least be related to it.

PERSONNEL POLICY

Conduct Attitude Surveys to Pinpoint Sources of
Discontent in C^2 Career Fields and Recommend Changes

Low retention rates of C^2 system personnel are a serious problem owing
to the importance of experienced individuals to the development,
implementation, and management of successful institutional and operational
training.

Policies affecting pay, work conditions, assignments, and career
opportunities need to be examined closely. Useful data for such policy
review could be obtained through an attitude survey. The state of the art
of surveying employee attitudes has advanced significantly in the last
several years. A concerted survey effort using current techniques would
provide a necessary data base for policy decisions, plus indicate to the C^2
community that the "employer" cares. The need to train new personnel
would be cut dramatically if retention of experienced individuals could be
enhanced.

The survey development and conduct would require on the order of six to
nine months. A half-time senior scientist, a full-time junior scientist, and
full-time research associate would be required. Expertise in industrial
and organizational psychology, organization, and human resources
development is required. In terms of Air Force resources, the cost of
implementing a developed survey would be negligible. The costs of policy
decisions resulting from recommendations are unknown.

The survey instrument could be included in an SRB. It could be used in other or related personnel areas as well.

Develop Instructor Resource Package
for Operational Unit Instructors

Most instructors in operations training programs have had little, if any, training in how to train. They are chosen primarily on the basis of their positional proficiency. More specifically, there exist no references for operations training program instructors to aid them in their job, the most important aspect of which is to ensure that individuals can function effectively in a team environment.

The Air Training Command runs a four-week instructor training course which could serve as the basis for instructor training in operational units. This course could be condensed and taught by a mobile training team or it could be offered strictly as a correspondence course. In any event, such a course should be required for all operational unit instructors.

The content of the course should be modified or expanded to include T^2 considerations. Instructor awareness of distinctions among the different AFC^2T^2 performance contexts, for example, could allow feedback to be delivered more appropriately. A description and discussion of team-oriented skills could focus instructor attention on those skills and allow more pertinent and timely feedback to be provided.

The development of an operational unit instructor training package would require one three-quarter time senior psychologist, one three-quarter

time junior psychologist, and one half-time research assistant. The effort could be completed in 9 to 12 months. A successful effort requires knowledge of AFC^2T^2 and training/instructional techniques. Economy in the contractor portion of this effort could be realized if ATC materials and personnel were directly involved.

A requirement for operational unit instructors to undergo training would add to their already heavy workload. However, the expected enhancement in training effectiveness would trade off well against this increased commitment.

If the training package were in a self-study format it would be ideal for inclusion in an SRB. The material would be directly usable by the instructors and should positively impact their ability to train effectively.

CHAPTER III

RECOMMENDATIONS FOR APPLICATION OF
CURRENT TECHNOLOGY

The preceding chapter discussed 11 application ideas which could lead to
immediate improvement of the development, implementation, or evaluation
of AFC^2T^2. The purpose of this chapter is first to select one application
topic for pursuit during the second phase of this contract effort and second
to describe the proposed Phase II effort in detail.

SELECTION OF APPLICATION TOPIC FOR PHASE II

All 11 application ideas should be undertaken in one form or another
because they address existing issues and problem areas in AFC^2T^2.
However, in the context of a Phase II effort the criteria of feasibility,
utility, usability, probability of success, and practical payoff must be
weighed in order to determine priorities. In this section these criteria are
defined and each application idea is evaluated on each criterion so as to
produce an overall priority ranking.

Feasibility

In the context of a Phase II effort feasibility means availability of time and
labor. Phase II must be conducted in nine months. It will involve a
fifth-time senior psychologist, a two-thirds-time junior psychologist, and
a two-thirds-time research assistant. Feasibility also considers the skills
available as compared to those required.

Utility

Utility refers to the pertinence of the effort to the conduct of Air Force training and operations.

Usability

The product of the effort must be usable by Air Force training personnel.

Probability of Success

The exis⋅ ⋅⋅e of data, techniques, and other resources will determine probability of success. Technical difficulty of achieving the application objective is also factored in.

Practical Payoff

If the effort is successful, to what degree will it positively impact the effectiveness or efficiency of AFC^2T^2 ?

Priority for Phase II

Table 4 summarizes the results of the consideration of the above criteria. Each criterion was judged on a five-point scale with 1 being low and 5 being high. The total of the ratings is simply a non-weighted sum and the rank is from highest total to lowest.

TABLE 4. PRIORITIZATION OF APPLICATION TOPICS

Topic	Feasibility	Utility	Usability	Probability of Success	Practical Payoff	Total	Rank
1. Taxonomy	0	3	2	3	1	9	11
2. Task Analysis Method	1	4	2	3	1	11	10
3. Readiness Criteria	1	5	3	4	5	18	5.5
4. SCM Guidelines/ Aids	2	5	4	4	4	19	4
5. C^2 Team Supervisor Training	5	5	4	5	5	24	1
6. Supplemental Initial Training	5	4	4	5	3	21	2
7. IPS Training	3	4	3	3	3	16	8
8. Program Evaluation Questionnaires	1	3	5	4	3	16	8
9. Compiling Procedure for AARs	5	5	2	3	5	20	3
10. C^2 Personnel Attitude Survey	3	2	5	5	3	18	5.5
11. Instructor Training	4	4	2	3	3	16	8

As can be seen from the table, the development of training for C^2 team supervisors (Topic 5) has the highest priority for the Phase II effort as defined by the constellation of evaluation criteria.

DEVELOPMENT OF C^2 TEAM SUPERVISOR TRAINING

In order to more fully define this Phase II topic the application context, objectives, approach, products, and required resources are reviewed and expanded on in this section.

Application Context

The Airborne Warning and Control System (AWACS) is recommended as the target application context. Furthermore, the Mission Crew Commander (MCC) position in AWACS is recommended as the C^2 team supervisor for whom to develop training materials.

AWACS provides capabilities in surveillance, warning, and control that were heretofore unattainable. The battle commander who is supported by an AWACS has dramatically increased chances of overall mission success. Furthermore, AWACS is a microcosm of larger (in terms of personnel), more complex C^2 systems and has a limited number of links to other components. It is therefore somewhat easier as compared to the TACC or CRC to specify input-output and network relationships among the AWACS mission crew and between the AWACS and other components.

These considerations mean that AWACS provides a high-payoff, tractable application context for the Phase II effort. In addition, because there is currently no formal training for the MCC, the development of training materials will fill an immediate need.

Objective

The objective of this effort is to demonstrate the feasibility of developing training material for a C^2 team supervisor and evaluate that material for appropriateness and training value. A parallel objective is to document the procedure whereby the training material is produced and, also, the evaluation results.

Approach

The approach will follow that used by McCutcheon and Brock (Reference 12) in their highly successful effort to develop training for the Combat Information Center Watch Officer (CICWO). The steps are as follows (these steps are presented in an annotated outline in Chapter IV of this volume):

1. Identify critical job tasks

2. Identify skill categories

3. Establish skill acquisition guidelines

4. Define exercise/experience characteristics

5. Select training media

6. Develop set of scripted exercises

7. Produce training materials

8. Evaluate materials

The present effort will focus on those job tasks requiring team-oriented decision-making and managerial skills in non-standard operational situations or situations for which operating procedures have not yet been developed. The identification of these types of job tasks will require on-site data collection and the assistance of a combat-ready MCC who has a background in training. The data collection effort will involve observation of live and simulated missions and interviews with combat-ready MCCs. A minimum of three live (flying) simulated combat missions will be observed with three different MCCs. These missions will be flown by operationally ready crews. If appropriate, that is, if an MCC participates, a minimum of two missions in the AWACS simulation facility will be observed. All observed missions will be followed as soon as practical by interviews with the MCCs involved. Furthermore, interviews with several additional MCCs will be conducted. In total, six to eight MCCs will be observed and interviewed and from this data base critical job tasks and events will be identified. It is estimated that the interviews will each take two hours to complete.

These data will be reviewed with the training-knowledgeable MCC; and based upon Air Force approval, the remainder of the steps outlined above will be carried out. No direct Air Force support is required again until step 6. After step 5, but before the scripted Human Resources Laboratory and AWACS exercises are produced, Air Force approval of the intermediate

results will be obtained. In particular, the exercise characteristics and selected media will be examined for relevance and validity. Finally, the scripted exercises produced in step 6 will be reviewed and approved before production.

The evaluation of the training materials produced will require on-site data collection consisting of demonstration and use of the materials. Both student and combat-ready MCCs will participate in the evaluation, possibly in a group setting. The primary evaluative tools will be observation of use and a questionnaire. It is estimated that each participant in the evaluation will be involved for two hours.

Product

It is envisioned that the product of this effort will consist of audio and/or visual programs supported by text. The programs will illustrate the team-oriented supervisory/decision skills required of the MCC during especially critical mission segments. The text and/or other media will contain descriptive information including background and a discussion of alternate actions and possible consequences. The materials will illustrate correct as well as incorrect decision/actions and their consequences.

Resources Required

Three on-site visits to Tinker Air Force Base will be required during this effort, as shown below.

Visit	Length (days)	Purpose	Period
1	7-10	Data Collection	15 May to 15 June 1981
2	1-2	Briefing on Intermediate Results	15 June to 30 June 1981
3	2-3	Demonstration/ Evaluation	15 August to 31 August 1981

A subject matter expert (training-knowledgeable MCC) will be required for occasional telephone consultation throughout the period of performance. The production of audio and/or visual materials from contractor-written scripts/text will be accomplished by Air Force audio/visual experts. The finished audio and/or visual presentation is expected to be no more than one hour in length. The production effort will take two to four weeks and will involve approximately three person-months.

Benefit

Knowledgeable, skilled leaders are essential for effective team performance. Formal training materials for C^2 team supervisors will enhance individual knowledge and skill, plus facilitate the standardization of training experiences. Providing the AWACS MCC a structured, systematic training experience outside of the job performance context will potentially reduce costs and increase operational readiness.

CHAPTER IV

ANNOTATED OUTLINE OF PROCEDURE FOR
DEVELOPING C^2 TEAM SUPERVISOR TRAINING MATERIALS

This chapter presents an annotated outline of the procedure which will be
used to develop training materials for C^2 team supervisors.

I.   INTRODUCTION

    A.   Describe Purpose of the Procedure

    B.   Discuss Philosophy Behind the Procedure

        1.   Systematic development of training

        2.   Based on ISD-like sequence

    C.   Give Overview of Procedure

        This overview will be presented in flow chart format.

II.   PROCEDURE

    A.   Develop Job Task List

        1.   The input to this step will be any existing data; for
            example, a job task inventory, procedural handbook;
            or, if data do not exist, the task list will be developed
            through observations and interviews.

        2.   The output of this step is a duty description that defines
            the actions, conditions, and desirable outcomes of job
            performance.

B. **Identify Skill Categories**

The job tasks must be mapped into skill categories. The emphasis will be on identifying cognitive, team-oriented skills. A partial list of these skills includes the following:

- Monitor
- Evaluate
- Recognize problems
- Make decisions
- Coordinate

- Communicate
- Resolve conflicts
- Adapt to emergent conditions
- Etc.

C. **Establish Skill Acquisition Guidelines**

In this step the guidelines for effective acquisition of the identified skills are established. These include:

1. Stimulus conditions
2. Complexity/difficulty criteria
3. Setting
4. Feedback characteristics

D. **Define Experience/Exercise Characteristics**

Based on the skill acquisition guidelines, the training experiences are fully defined and described.

E. **Select Appropriate Media**

Based on the experience/exercise characteristics, appropriate training media are selected. The demonstrated success of the observational/experiential learning approach of McCutcheon and Brock (Reference 12) will weigh heavily in media selection.

F. Develop Set of Scripted Exercises

This is the final step before production. Review of the
scripts by subject matter experts is essential. The exercises
will illustrate correct techniques and errors as examples.
Errors of omission, commission, and timing will be
illustrated along with their operational consequences.

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